Chapter 11. Colorado River Hydrologic Region

Setting

The Colorado River Hydrologic Region is in southeast California. The Colorado River forms most of the region's eastern boundary and Mexico forms its southern boundary (Figure 11-1 on page 11-21 is a map and table of statistics that describe the region). The region includes all of Imperial County, approximately the eastern one-fourth of San Diego County, the eastern two-thirds of Riverside County, and about the southeastern one-third of San Bernardino County. The Colorado River Region contains 12 percent of the State's land area. It has many bowl-shaped valleys, broad alluvial fans, sandy washes, and hills and mountains.

Owing to hydrologically-determined boundaries, the Colorado River region includes a portion of the Mojave Desert, primarily that part of the region within San Bernardino County and eastern Riverside County. The area to the east and south of the Mojave Desert is a portion of the Sonoran Desert. Elevations in the region mostly range from 1,000 to 3,000 feet in the Mojave Desert to less than 1,000 feet along the Colorado River, to more than 200 feet below mean sea level in the Coachella and Imperial Valleys. Mountain peaks attain elevations of 6,000 to 7,000 feet. Many of the valleys contain playas. Some playas are quite large. Bristol Dry Lake, located near the Mojave National Preserve, covers more than 50 square miles.

Climate

Nearly all of the Colorado River Region has a subtropical desert climate with hot summers and mostly mild winters, and the average annual rainfall is quite small. Average annual precipitation ranges from three to six inches, most of which occurs in the winter. However, summer storms do occur and can be significant in some years. Clear and sunny conditions typically prevail. The region receives from 85 to 90 percent of possible sunshine each year, the highest value in the United States. Winter maximum temperatures are mild, but summer temperatures are very hot, with more than 100 days over 100 degrees Fahrenheit each year in the Imperial Valley.

Population

In 2000, the estimated population for the Region was about 606,000, which represented an increase of 31 percent from the 1990 population. More than half of the region's population resides in the Coachella Valley. Most of the remaining population is in the Imperial Valley and in the corridor between the cities of Yucca Valley and Twenty-nine Palms along Highway 62. Between the years 2000 to 2030, the California Department of Finance projects that the regional population will almost double to 1,166,550 people. Figure 11-2 provides a graphical depiction of the Colorado River region's total population from year 1960 through year 2000, with projections to year 2030.

Land Use

The region is a land of unequalled agricultural bounty with a growing urban sector, and large expanses of open, wild terrain. The U. S. Bureau of Land Management (BLM) administers much of the Region, but many other entities have responsibilities.

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Famous parks in the region include Joshua Tree National Park, the Mojave National Scenic Preserve, Anza-Borrego Desert State Park, and the Salton Sea and the Picacho State Recreation Areas. There are also several areas under some kind of preservation or managed status, including national recreation and wilderness areas, various preserves and wildlife refuges, Indian reservations, and US Navy facilities.

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Despite the arid conditions, significant areas of agricultural and urban land uses exist in the region. The most prominent of these uses belongs to agriculture. More than $1.5 billion of agricultural commodities are produced in the region annually. Over 600,000 acres of land are farmed each year. The largest area of farming occurs in the Imperial Valley where over 450,000 acres of land are farmed annually. More than 93,000 acres are farmed in the Palo Verde Valley, followed by 60,000 in the Coachella Valley. Smaller, but equally important agricultural operations are occurring in the Bard and Mohave Valleys.

A wide variety of crops are planted and harvested in the region, some of which grow only during certain seasons. In terms of acres, alfalfa is the leading crop produced in the region. Almost 250,000 acres were grown in 2000, of which 180,000 acres were in the Imperial Valley. Although constrained by summer climate, winter and spring vegetables, which include carrots, broccoli, lettuce, onions, and melons, rank second in overall acres. Of the 150,000 acres harvested, almost 100,000 acres of the vegetables harvested in 2000 came from the Imperial Valley.

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Salton Sea

The present day Salton Sea was formed in 1905, when Colorado River water flowed through a break in a canal that had been constructed along the U.S./Mexican border to divert the river's flow to agricultural lands in the Imperial Valley. Until that break was repaired in 1907, the full flow of the river was diverted into the Salton Sink, a structural trough whose lowest point is about 278 feet below sea level.

Historically, the Colorado River's course has altered several times. At times, the river discharged to the Gulf of California as it does today. At other times it flowed into the Salton Sink. Lake Cahuilla, the name used for any of the several prehistoric lakes to have occupied the Salton Sink, dried up some 300 years ago. In the past 2000 years, archaeological records indicate that the Colorado River actually headed northwest into the Salton Sink or Trough more often than it headed south into the Gulf of California.

The Coachella and Bard Valleys are noteworthy for citrus and subtropical fruit production, especially dates. Also, the table grape industry in the Coachella Valley is well established.

The cattle industry in Imperial Valley is extremely important to the valley's $1 billion per year agricultural production. In 2001, the cattle industry, with a value of $243 million, ranked as the third highest-valued commodity produced in the Valley. Ranked first were vegetable and melon crops worth $403 million, while field crops were worth $285 million.

Other important crops grown in the region include wheat, sugar beets, and Sudan grass. Although less cotton is grown now than at its peak in the early 1980s, cotton is still grown in the region, mostly in the Palo Verde Valley.

It should be noted that multiple-cropping is prevalent in the Imperial, Palo Verde, Coachella, and Bard Valleys. In 2000, it was estimated that over 100,000 acres were double-cropped in the region.

Contrasting urban land uses co-exist with agriculture in the region. In the Imperial and Palo Verde Valleys and the southern one-half of the Coachella Valley, small to moderately sized cities and

communities provide support for the surrounding agricultural and non-agricultural activities. There are also numerous single-family residential dwellings scattered throughout the region. Many of the business and industrial sectors in the Cities of Blythe, Brawley and Indio provide this kind of support.

In the northern Coachella Valley, the urban area continues to expand between the Cities of Palm Springs and Indio. Other cities around this area include Palm Desert, Rancho Mirage, and La Quinta. This corridor is characterized by the presence of numerous extensively landscaped residential developments, expansion of local business and consumer service centers, construction of luxury hotels and resort properties, and the operation of over 100 private and public golf courses. Upscale commercial and residential expansion, which has been underway for several decades, is continuing at a robust pace. The expansion supports the region's recreation and tourism industry and its growing number of wealthy retirees and part-time residents.

Although smaller in scale, the region's urban area in the corridor between the Cities of El Centro and Imperial and within and around the City of Calexico has also been expanding. Business and consumer services there support consumers in the Imperial Valley and from the neighboring Mexicali Valley, with a third port of entry opened in 2001 to support increased traffic resulting from NAFTA.

Acronyms Used in the Colorado River Regional Report

BWD – Bard Water District

CVWD – Coachella Valley Water District

DFG – California Department of Fish and Game

DWA – Desert Water Agency

DWR – California Department of Water Resources

IID – Imperial Irrigation District

LCR MSCP – Lower Colorado River Multi-Species Conservation Program

MWD - Metropolitan Water District of Southern California

PVID – Palo Verde Irrigation District

QSA – Quantification Settlement Agreement of 2003

SGPWA – San Gorgonio Pass Water Agency

SDCWA – San Diego County Water Authority

SSAM – Salton Sea Accounting Model

SWP – State Water Project

USBR – United States Bureau of Reclamation

USFS – United States Fish and Wildlife Service

Water Supply and Use

About 85 percent of the region's urban and agricultural water supply is from surface deliveries from the Colorado River. Water from the river is delivered into the region through the All-American and Coachella Canals, local diversions, and the Colorado River Aqueduct by means of an exchange for State Water Project (SWP) water. The Colorado River is an interstate and international river whose use is apportioned among the seven Colorado River Basin states and Mexico by a complex body of statutes, decrees, and court decisions known collectively as the "Law of the River" (Table 11-1). Local surface water, groundwater, and the SWP (Table 11-6) provide the remainder of water to the region. Many of the alluvial valleys in the region are underlain by groundwater aquifers that are the sole source of water for local communities, however. There are other alluvial valleys that have poor quality water that is not suitable for potable use. Figure 11-3 presents a bar chart that summarizes all of the dedicated and developed urban, agricultural and environmental water uses within this hydrologic region for years 1998, 2000 and 2001. Figure 11-4 provides a graphical presentation of all of the water supply sources that are used to meet the developed water uses within this hydrologic region for years 1998, 2000 and 2001.

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Table 11-1
Key Elements of the Law of the River

Document	Date	Main Purpose
Colorado River Compact	1922	The Upper Colorado River Basin and the Lower Colorado River Basin are each provided a basic apportionment of 7.5 maf annually of consumptive use. The Lower Basin is given the right to increase its consumptive use an additional 1 maf annually.
Boulder Canyon Project Act	1928	Authorized USBR to construct Boulder (Hoover) Dam and the All-American Canal (including the Coachella Canal), and gave congressional consent to the Colorado River Compact. Provided that all users of Colorado River water must enter into a contract with USBR for use of the water.
California Limitation Act	1929	Limited California's share of the 7.5 maf annually apportioned to the Lower Basin to 4.4 maf annually, plus no more than half of any surplus waters.
Seven Party Agreement	1931	An agreement among seven California water agencies/districts to recommend to the Secretary of the Interior how to divide use of California's apportionment among the California water users.
U.S. - Mexican Treaty	1944	Apportions Mexico a supply of 1.5 maf annually of Colorado River water except under surplus or extraordinary drought conditions.
U.S. Supreme Court Decree in *Arizona v. California, et al.*	1964	Apportions water from the mainstream of the Colorado River among the Lower Division states. When the Secretary determines that 7.5 maf of mainstream water is available, it is apportioned 2.8 maf to Arizona, 4.4 maf to California, and 0.3 maf to Nevada. Quantifies tribal water rights for specified tribes, including 131,400 af for diversion in California.
Colorado River Basin Project Act	1968	Authorized construction of the Central Arizona Project. Requires Secretary of the Interior to prepare long-range operating criteria for major Colorado River reservoirs.
U.S. Supreme Court Decree in *Arizona v. California, et al.* supplemental decrees	1979, 1984, 2000	Quantifies Colorado River mainstream present perfected rights in the Lower Basin states.
Quantification Settlement Agreement and Related Agreements	2003	Complex package of agreements that, among other things, further quantifies priorities established in the 1931 Seven-Party Agreements and enables specified water transfers in California.

Within California, the Seven Party Agreement of 1931 (Tables 11-2, 11-3, 11-4) established local agencies' apportionments of Colorado River water, with Priority 3 further defined in the Quantification Settlement Agreement of 2003 (Table 11-5). The Secretary of the Interior apportions water to California water users according to the Seven Party and the Quantification Settlement Agreements (QSA). Water use that occurs within a state is charged to that state's allocation. Thus, federal water uses, including uses associated with federal reserved rights (e.g., tribal water rights), must also be accommodated within California's basic apportionment of 4.4 million acre-feet per year plus one-half of any available surplus water.

Table 11-2
Annual Apportionment of Water from the Colorado River Mainstream and its Tributaries
(amounts represent consumptive use)

Interstate/International	
Upper Basin States. Required to deliver 75 maf over a 10-year period measured at Lee Ferry. (small portion of Arizona, Colorado, New Mexico, Utah, and Wyoming)	7.5 maf
Lower Basin States (portions of Arizona, California, Nevada, New Mexico, and Utah draining below Lee Ferry)	7.5 maf plus 1 maf
Republic of Mexico [a]	1.5 maf
Total	17.5 maf[b]
a. Plus 200 taf of surplus water, when available as determined by the United States. Water delivered to Mexico must meet specified salinity requirements. During an extraordinary drought or other cause resulting in reduced uses in the United States, deliveries to Mexico would be reduced proportionally with uses in the United States.	
b. The total volume is (7.5 + 7.5 + 1.0 + 1.5) = 17.5 maf/yr. Note that this total refers to all waters of the Colorado River System, which is defined as that portion of the Colorado River and its tributaries in the United States.	

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Table 11-3
Annual Apportionment of Water from the Colorado River Mainstream to the Lower Basin
(amounts represent consumptive use)

Arizona	2.8 maf
Nevada	0.3 maf
California	4.4 maf
Total	7.5 maf

Table 11-4
Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement [c]
(amounts represent consumptive use)

Priority 1	Palo Verde Irrigation District for beneficial use on 104,500 acres of lands within the Palo Verde Valley.
Priority 2	USBR's Yuma Project in California for beneficial use on up to 25,000 acres of lands within said Project
Priority 3	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa.
Priorities 1 through 3 collectively are not to exceed 3.85 maf/yr. The Seven Party Agreement did not quantify the division of this volume among the three priorities. Priority 3 was further defined in the 2003 Quantification Settlement Agreement.	
Priority 4	Metropolitan Water District of Southern California (MWD) for coastal plain of Southern California – 550 taf/yr.
Priority 5	An additional 550 taf/yr to MWD, and 112 taf/yr for the City and County of San Diego [d].
Priority 6[e]	Imperial Irrigation District and lands served from the All-American Canal in Imperial and Coachella Valleys and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa, for a total not to exceed 300 taf/yr.
Total of Priorities 1 through 6 is 5.362 maf/yr.	
Priority 7[e`]	All remaining water available for use in California, for agricultural use in California's Colorado River Basin.
c. Indian tribes and miscellaneous present perfected right holders that are not encompassed in California's Seven Party Agreement have the right to divert up to approximately 90 taf/year (equating to about 50 taf/yr of consumptive use) within California's 4.4 maf/yr basic apportionment. Present consumptive use under these miscellaneous and Indian present perfected rights is approximately 15 taf/yr.	
d. Subsequent to execution of the Seven Party Agreement, MWD, SDCWA, and the City of San Diego executed a separate agreement transferring its apportionment to MWD.	
e. Under the 2003 Quantification Settlement Agreement, MWD (& SDCWA) gained access to water that may be available under Priority 6 and 7,	

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Table 11-5
Quantification Settlement Agreement for Priorities 1- 3
Annual Use of Colorado River Water by California Agencies
(amounts represent consumptive use)

	Priority 3 Quantification	Approved Net Consumptive Use in 2003 [a]	Approved Net Consumptive Use by 2030 [a]
Priority 1,2, and 3b – Based on historical average use; deliveries above this amount in a given year will be deducted from MWD's diversion (order) for the next year; as agreed by MWD, IID, CVWD, and Secretary of the Interior (PVID & Yuma Project are not signatories to the QSA and are unaffected by it)	420 taf	420.0 taf	420.0 taf
Imperial Irrigation District	3,100 taf	2972.2 taf	2607.8 taf
Coachella Valley Water District	330.0 taf	347.0 taf	424.0 taf
Total Priority 1-3 Use	3,850 taf	3745.0 taf	3466.3 taf
Remainder of 3.85 for use by MWD (& SDCWA) through priority rights and transfer agreements	0 taf	105.0 taf [b]	383.7 taf [b]
a. Consumptive use is defined in the QSA as "the diversion of water from the main stream of the Colorado River, including water drawn from the main stream by underground pumping, net of measured and unmeasured return flows."			
b. Includes miscellaneous present perfected rights, federal rights reserved, and decreed rights.			

Table 11-6
SWP Contractors in the Colorado River Region
Annual Delivery to California Agencies in the Colorado River

	Maximum Annual Deliveries	SWP Deliveries in 2000
Coachella Valley Water District	23.1 taf	42.3 taf
Desert Water Agency	38.1 taf	58.2 taf
Mojave Water Agency (a)	75.8 taf	11.2 taf
San Gorgonio Pass Water Agency	17.3 taf	0.0 taf
Total SWP Delivery	153.3 taf	111.7 taf
a Maximum Annual Deliveries include amounts for both the South Lahontan and Colorado River Regions; 7.3 taf of this amount is allocated to Colorado River Region.		

Neither Coachella Valley Water District (CVWD) nor Desert Water Agency (DWA) has facilities to take direct delivery of SWP water. Instead, both agencies have entered into exchange agreements with the Metropolitan Water District of Southern California (MWD), whereby MWD releases water from its Colorado River Aqueduct into the Whitewater River for storage in the upper Coachella Valley groundwater basin. In exchange, MWD takes delivery of an equal amount of the agencies' SWP water. San Gorgonio Pass Water Agency (SGPWA), which serves the Banning-Beaumont area, also lacks the facilities to take delivery of SWP water into the portion of its service area which is within the Colorado River Region. However, SGPWA is currently delivering SWP water into the Santa Ana Planning Area of the South Coast Hydrologic Region. When Phase 2 of the East Branch Extension is completed, SWP water will be delivered into the Colorado River Hydrologic Region; however, the California Department of Water Resources (DWR) is still planning for that Phase.

Groundwater provides about 7.5 percent of the region's applied water supply in normal years and about 7.7 percent in drought years (DWR 1998). Groundwater storage capacity is reported for 40 of the region's

57 groundwater basins and is estimated to be more than 175 million acre-feet. The largest water-using area in the region, the agricultural area of the Imperial Valley, is mostly on top of a saline basin. Therefore, it lacks usable groundwater.

In the Coachella Valley, groundwater levels began declining in the late 1920s. Since 1948, imported water supplies from the Colorado River via the Coachella Canal have enabled decreased pumping of groundwater in the southeastern portion of the valley and helped recharge the basin. In response, groundwater levels rose in this part of the valley. However, in the 1980s, these levels began to decline again because of urban development and increased groundwater pumping.

Local water districts in the Coachella Valley have been addressing the decline in groundwater levels. The move by CVWD and DWA to bring in SWP supplies was an important first step. In 1984, an agreement was reached among CVWD, DWA, and MWD that allowed for the advanced deliveries of Colorado River water to the Coachella Valley during high flows on the river. These supplies helped speed the pace of replenishment of the basin and provided water for future uses; however, groundwater levels continue to decline in much of the basin.

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Under the 1984 agreement, MWD was also permitted to bank up to 600,000 acre-feet in the groundwater basin. When needed, MWD will take its Colorado River water along with CVWD's SWP allocations and CVWD will use the banked water until it is gone.

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In 2000, the estimated applied water demands for urban, agriculture, and the environment for the Colorado River Region were 4,709,000 acre-feet. Most of the demands are for agriculture, about 85 percent. In 2000, the estimated applied water demand for agriculture was 4,009,000 acre-feet. Beginning in October 2003, demands will be restricted based upon terms of the QSA and related agreements.

Almost all of the agricultural demands in the region occur in the three major agricultural areas described earlier, the Imperial, Palo Verde, and Coachella valleys. The Imperial Valley, with more than 500,000 acres of crops (including double cropping) harvested each year, accounts for almost 70 percent of the total applied water demands for the region. In the Imperial and Palo Verde valleys, all agricultural demands are met with water from the Colorado River. In the Coachella Valley, agricultural demands are met through a combination of Colorado River water and groundwater.

Urban applied water demands account for about 15 percent of the overall totals for the Colorado River region. In 2000, urban demands were estimated to be 673,000 acre-feet. Most of these demands occur in the Coachella Valley; 527,000 acre-feet in 2000 or almost 80 percent of the total applied water for the region's urban use. Established housing and commercial uses have been augmented by large housing tracts with intensive landscaping, hotels, shopping centers, country clubs, golf courses, and polo fields. Landscape irrigation demands in the Coachella Valley are large because of the expanse of turf grass and landscaping that have occurred in the past two decades.

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Despite the availability of reliable and inexpensive water, water districts and users know the importance of water conservation programs to effectively use and manage water. The growers in all of the districts do precision land forming for specific crops, and use plastic and other mulches to reduce evapotranspiration and improve productivity and/or market timing.

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For the past 50 years, the Imperial Irrigation District (IID), the region's largest water district, has implemented programs and completed projects designed to improve the efficiency of its water conveyance system. Under the 1988 IID/MWD Water Conservation Agreement, and Approval Agreement in 1989, 15 new projects were completed, including the construction of three lateral interceptors serving more than 83,400 acres, the building of two regulatory reservoirs and four interceptor reservoirs, concrete-lining of nearly 200 miles of lateral canals, and installation of new hardware and software to upgrade the existing telemetry control on its conveyance system, along with a new, state-of-the-art Water Control Center. These infrastructure upgrades complemented IID programs including farmer-initiated measures, canal lining, canal seepage recovery, and regulatory reservoirs.

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In addition to the improvements to its water conveyance system, IID also implemented 13- and 21-Point Water Conservation Programs. IID also provides training and technical assistance to its agricultural customers through its Irrigation Management and Monitoring program. Its most valued service has been the dissemination of information to farmers and irrigation personnel on methods to improve their irrigation operations. Moreover, the program actively promotes the use of the following methodologies and instruments to improve irrigation efficiencies: level basin drip systems, level basin laser-leveling, irrigation scheduling, portable pump-back and tailwater return systems, salinity assessment, soil moisture sensors. IID has a training program that it uses to provide growers with flow records, based on metering of the delivery and tailwater, for a particular irrigation.

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In addition to the water supply savings in the IID/MWD agreement, improvements to IID's water distribution system and other water conservation activities conserve more than 525,000 acre-feet of water annually. Of this amount, the IID estimates that 385,000 acre-feet of the savings are attributable to the efforts by its agricultural customers.

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CVWD has also made important improvements to its water conveyance system. Water is delivered to its agricultural customers through metered, underground pipelines. The conveyance system is computerized, which adds to the system's efficiency. In addition to the infrastructure improvements, CVWD provides technical services in efficient irrigation management to its agricultural and residential customers.

The districts have also examined their water operation policies and procedures. This review has resulted in modifications in the delivery procedures that have improved efficiencies and assisted farmers in their irrigation scheduling.

Palo Verde Irrigation District (PVID) has installed telemetry controls for more than 132 key control structures, which has improved the management of water in its canals. Most of the fields in the PVID and other district service areas have been laser-leveled. Flattened fields help improve the uniform distribution of water. All deliveries to the PVID's retail agricultural customers are measured, as are IID's and CVWD's.

PVID, IID, and CVWD, with the University of California Cooperative Extension and DWR, have installed CIMIS stations to collect the climatological data its agricultural water users need to estimate crop evapotranspiration of applied water (ETAW) and develop irrigation schedules. Water users are made aware of improvements in irrigation management and crop growing procedures through local farmers and water conservation advisory boards.

To assist CVWD, PVID entered into an emergency six-month fallowing program in 2003. More than 16,417 acres of farmland were idled and the unused water, 41,000 acre-feet, was transferred to CVWD.

IID, PVID, and CVWD signed a Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California. By signing the MOU, the districts demonstrated their intention to adopt and use agricultural water management plans that would improve agricultural water management and have beneficial environmental impacts within their service areas. IID's *2002 Agricultural Water Management Plan* has been endorsed by the Agricultural Water Management Council that oversees the MOU.

Growers in the major agricultural areas use the latest irrigation hardware and management techniques to increase both the efficiencies of their operations and crop yields. In the Imperial Valley, it is common to see drip, micro-sprinklers, and drip tape systems being used along with the traditional systems of furrow, basin, and hand-move sprinklers. Drip tape is most commonly used for high-market value crops such as vegetables. Drip and micro-sprinkler systems are commonly used to irrigate the citrus and subtropical fruit orchards; less than one (1) percent of the orchard acres, mainly date palms, are flood irrigated.

Most irrigation operations with vegetables and truck crops in Coachella Valley use drip tape and hand-move sprinklers. Some furrow irrigation is still used. Citrus and subtropical fruit orchard irrigation is done with drip and micro-sprinklers; although flood or basin irrigation is used for mature date palms. Almost all the vineyards are being irrigated by some type of drip system; only a very small portion still rely on furrow irrigation. The use of overhead sprinkler systems are a common sight in vineyards throughout the valley, where they are used for frost protection and the inducement of vine dormancy for earlier fruit-sets.

Although most of the water conservation has been directed to agriculture, water districts in the Coachella Valley provide technical assistance to the managers of large landscaped areas, such as golf courses, to evaluate and offer suggestions about irrigation hardware and operations. CVWD provides loans to its retail customers for irrigation upgrades. Desert Water Agency offers classes in English and Spanish to homeowners, property managers, and government and school personnel on irrigation efficiency strategies and

Salton Sea Ecosystem

The Salton Sea, a saline lake with total dissolved solids of approximately 44,000 ppm (mg/L) – 25 percent greater than that of ocean water – is California's largest (surface area) lake and has been famous for its sport fishing and other recreational uses. It is also a federally designated repository to receive and store agricultural, surface, and subsurface drainage waters from the Imperial and Coachella valleys. The Salton Sea has a water surface elevation of about 228 feet below mean sea level.

Wildlife and aquatic species, which are dependent upon habitat created by the discharge of agricultural return flows, are threatened by the salinity of the sea, which increases over time as salts in the water are concentrated through evaporation. The sea's importance to wildlife has grown because about 95 percent of California's wetlands in other areas have disappeared through changes in land use.

The Salton Sea ecosystem, including the Sonny Bono Salton Sea National Wildlife Refuge, is considered a critical link on the International Pacific Flyway for migratory birds. The amount of freshwater inflow to the Sea will be affected by water transfers to the South Coast region as well as by water conservation in Mexico. As required by the State Water Resources Control Board, IID is required to provide a defined freshwater inflow from 2003 through 2017.

By the end of 2006, California's Secretary for Resources is required to complete a Salton Sea ecosystem restoration study and an environmental document and identify a preferred alternative for "Salton Sea Restoration."

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The largest water body in the region is the Salton Sea, a saline body of water about 50 feet deep. Today's surface water elevation is about 228 feet below sea level. The Salton Sea has a concentration of total dissolved solids of about 44,000 mg/L, which is 25 percent greater than that of ocean water. Most of the environmental water demands in the region are for the Sonny Bono Salton Sea National Wildlife Refuge, DFG, Imperial Wildlife Area, wetland areas on the shore of the Salton Sea, and to maintain the viability of the sea under the QSA through 2017. To meet conditions for the IID/SDCWA transfer approved under the 2003 Colorado River QSA, from 2003 through 2017, IID will fallow enough ground to provide 800,000 acre-feet to the Salton Sea as mitigation for transferring 700,000 acre-feet to San Diego. The Salton Sea ecosystem is considered a critical link on the international Pacific Flyway, providing wintering habitat for migratory birds, including some species whose diets are based exclusively on fish. The expected average annual inflows to the Salton Sea during the 30-year time frame of the California Water Plan Update 2004 are expected to be approximately 962,000 acre-feet per year, based on estimates using the Salton Sea Accounting Model (SSAM). The estimate has a standard deviation sensitivity range of approximately +/- 100,000 acre-feet per year.

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Water Balance Summary Table 11-8 on page 11-23 summarizes the detailed water portfolio accounting for this region. As shown in the table, imports make up a substantial portion of the applied water supply in the region. Water Use and Distribution Table 11-10 summarizes the dedicated and developed urban, agricultural and environmental water uses in the region for 1998, 2000 and 2001. Water Portfolio Table 11-9 and the three companion Water Portfolio flow diagrams (Figures 11-5, 11-6 and 11-7) provide more detailed information about how the available water supplies are distributed and used on a region-wide basis.

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State of the Region

Challenges

Threatened or endangered fish species on the mainstem of the Colorado River include the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub. Efforts to protect these fish may affect reservoir operation and streamflow in the mainstem and tributaries. Other species of concern in the basin include the bald eagle, Yuma clapper rail, black rail, southwestern willow flycatcher, yellow warbler, vermilion flycatcher, yellow-billed cuckoo, and Kanab ambersnail.

In 1993, the UFSWS) published a draft recovery implementation plan for endangered fish in the upper Colorado River Basin. The draft plan included protecting instream flows, restoring habitat, reducing impacts of introduced fish and sportsfish management, conserving genetic integrity, monitoring habitat and populations, and increasing public awareness of the role and importance of native fish.

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Problems facing native fish in the mainstem Colorado River and its tributaries will not be easily resolved. For example, two fish species most in danger of extinction, the bonytail chub and razorback sucker, are not expected to survive in the wild. In recent years, most stream and reservoir fisheries in the basin have been managed for non-native fish. These management practices have harmed residual populations of natives. Many native fish are readily propagated in hatcheries, and thus recovery programs include captive broodstock programs to maintain the species.

Reestablishing wild populations from hatchery stocks will have to be managed in concert with programs that manage river habitat. For example, although 15 million juvenile razorback suckers were planted in Arizona streams from 1981-1990, the majority of these planted fish were likely eaten by introduced predators. In 1994, the states of Colorado, Wyoming, and Utah reached an agreement with USFWS on protocols for stocking non-native fish in the Upper Basin. Stocking protocols are consistent with native fish recovery efforts. In a program which began in 1989, USBR and other federal and state agencies have cooperated to capture, rear, and successfully reintroduce about 15,000 razorback sucker larvae in Lake Mohave.

Instream flows in the mainstem and key tributaries are being evaluated as components of native fish recovery efforts. State and federal agencies are conducting studies to estimate base flow and flushing flow needs for listed and sensitive species in various river reaches.

In the Lower Colorado River Basin, representatives of the three states, federal agencies, several Native American tribes, and Colorado River water and power users have completed and signed the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). The LCR MSCP is intended to provide long-term compliance with the federal and California Endangered Species Acts and California fully protected species statutes.

The LCR MSCP is a 50-year program that is designed to provide more than 8,100 acres of high quality aquatic, wetland, and native broadleaf riparian habitat along the Lower Colorado River from Lake Mead to the Southerly International Boundary with Mexico. The restored and maintained habitats are expected to provide ecological benefits and mitigate potential impacts to 26 covered species being addressed within the LCR MSCP. Some of the proposed habitat restoration may involve the conversion of existing agricultural lands to native riparian habitats, as well as removal of non-native salt cedar (tamarisk) and replacement with native broadleaf riparian habitat – cottonwood, willow, and mesquite, for example.

Additionally, the LCR MSCP participants plan to rear and repatriate to the mainstream more than 660,000 razorback suckers and 620,000 bonytail during the 50-year LCR MSCP. More than 360 acres of backwater habitats are to be created along the Lower Colorado River to provide nursery habitat for juvenile native fish and additional wetland habitat for marsh species and migratory waterfowl.

California's Colorado River water and power using agencies and entities were participants in the LCR MSCP planning process and are signatories to the plan. The LCR MSCP is expected to begin implementation in early 2005. The USBR, in conjunction with representatives of the three states and the U.S. Fish and Wildlife Service, will be the agency primarily responsible for implementing the LCR MSCP.

The Salton Sea, with its increasing salinity, selenium, and eutrophication, is the primary focus of water quality issues in the Colorado River region. The largest sources of the sea's inflow are the New and Alamo rivers and the Imperial Valley agriculture drains, all of which contribute pesticides, nutrients, selenium, and silt. The New River is the most polluted river in the U.S. Originating in Mexicali, Mexico, the New River flows across the border, through the city of Calexico, and then north, and empties into the Salton Sea. It conveys urban runoff, untreated and partially treated municipal and industrial wastes from the Mexicali Valley, and agricultural runoff from the Mexicali and Imperial valleys. These pollution sources contribute pesticides, pathogens, silt, nutrients, trash, and VOCs (the latter, primarily from

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Mexican industry) to the sea. Both the Alamo River, which originates just two miles south of the border and also flows north to the Salton Sea, and the Coachella Valley Stormwater Channel, which flows south to the sea, consist mainly of agricultural return flows from the Imperial and Coachella valleys, respectively. The Coachella Valley Stormwater Channel, which also drains to the sea, is heavily contaminated with pathogens.

A multi-agency group, The Citizen's Congressional Task Force on the New River, was created in 1997. Their mission is to improve agricultural drain water quality that flows into the New River and, ultimately, to the Salton Sea. Participating agencies include IID, Desert Wildlife Unlimited, County of Imperial, USBR, U.S. Geological Survey, USFS, DFG, California Regional Water Quality Control Board, USEPA, Ducks Unlimited, and U.C. Riverside. In 2000, the Task Force constructed two pilot sites, a seven-acre site near Brawley and a 68-acre site near Imperial, to test the effectiveness of constructed wetlands in lowering non-point source pollutants. Due to the success of the pilot sites, up to thirty additional wetland sites are anticipated for construction on both the New and Alamo rivers. For additional information, see the Task Force web site www.newriverwetlands.com.

Contamination in the Salton Sea presents threats to migrating birds on the Pacific Flyway. At some times of the year, nutrient loading to the sea supports large algal blooms that contribute to odors, as well as low dissolved oxygen levels that adversely affect fisheries. Selenium is a more recent constituent of interest, potentially affecting fish and wildlife.

The relatively saline Colorado River provides irrigation and domestic water to much of Southern California. Of recent concern to human health is the presence of low levels of perchlorate in the Colorado River from a Kerr-McGee chemical facility in the Las Vegas Wash, the nation's largest perchlorate contamination site. Also, high levels of hexavalent chromium occur in wells near Needles, from a PG&E natural gas compressing station. Septic systems at recreational areas along the river are also a concern for domestic and recreational water uses. Other important water quality issues in this region include rising levels of salinity, nitrates and other substances in groundwater associated with animal feeding and dairy operations and septic tank systems, especially in the Desert Hot Springs area and in the Cathedral City Cove area. In the Coachella Valley, nitrates restricte the use of several domestic water supply wells.

To address the issue of declining groundwater levels, CVWD and DWA have prepared a groundwater management plan for the lower valley. They have considered alternatives that include basin adjudication, water conservation, water recycling and direct or in lieu recharge with water imported from the Colorado River or from the SWP. The plan was completed in 2002.

As a result of a 1964 U.S. Supreme Court decree in Arizona v. California, California's basic apportionment of Colorado River water was quantified and five lower Colorado River Indian tribes were awarded 905,000 acre-feet of annual diversions, 131,000 acre-feet of which were allocated for diversion in and chargeable to California pursuant to a later supplemental decree.

In 1978, the tribes asked the court to grant them additional water rights, alleging that the U.S. failed to claim a sufficient amount of irrigable acreage, called omitted lands, in the earlier litigation. The tribes also raised claims called boundary land claims for more water based on allegedly larger reservation boundaries than had been assumed by the court in its initial award. In 1982, a Special Master appointed by the Supreme Court to hear these claims recommended that additional water rights be granted to the

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tribes. In 1983, however, the U. S. Supreme Court rejected the claims for omitted lands from further consideration and ruled that the claims for boundary lands could not be resolved until disputed boundaries were finally determined.

Three of the five tribes – the Fort Mojave Indian Tribe, the Fort Yuma-Quechan Indian Tribe, and the Colorado River Indian Tribe – are pursuing additional water rights related to the boundary lands claims. A settlement has been reached on the claim of the Fort Mojave Indian Tribe, and a settlement may soon be reached on the claim of the Colorado River Indian Tribe. Both settlements would then be presented to the Special Master. The claim of the Fort Yuma-Quechan Indian Tribe was rejected by the Special Master on the grounds that any such claim was necessarily disposed of as part of a Court of Claims settlement entered into by the tribe in a related matter in the mid-1980s. As with all claims to water from the mainstem of the Colorado River and any determination by the Special Master, only the U.S. Supreme Court can make the final ruling. If both the Fort Mojave and the Colorado River Indian tribe settlements were approved, the tribes would receive water rights in addition to the amounts granted them in the 1964 Supreme Court decree.

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Through legislation enacted in 2003 to enable the local agency QSA signatories to reach agreement on how to reduce their use of Colorado River water to California's basic interstate apportionment of 4.4 million acre-feet annually, the State of California accepted significant responsibilities and liabilities for mitigation of QSA environmental impacts and for restoration of the Salton Sea ecosystem. The QSA implementation legislation is contained in three bills chaptered in 2003 – SB 277 (Ducheny), SB 317 (Kuehl), and SB 654 (Machado). Among other things, the legislation establishes State policy with respect to the Salton Sea, stating the intent of the Legislature that the State undertake the restoration of the Salton Sea ecosystem and permanent protection of its fish and wildlife. It provides that no further funding obligations or in-kind contributions for Salton Sea restoration would be required of IID, CVWD, MWD, or SDCWA. Any future actions to restore the Salton Sea would be the sole responsibility of the State. Additionally, IID is held harmless from Salton Sea impacts resulting from transfers of conserved water.

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With respect to QSA implementation, the legislation authorizes the DFG to issue incidental take permits for California fully protected species, and provides that DFG chair a joint powers authority whose other members are SDCWA, IID, and CVWD. The three local agencies are to contribute $133 million to the joint powers authority for QSA environmental mitigation, with the State being responsible for mitigation in excess of that amount. The three local agencies are also to contribute $30 million to a Salton Sea Restoration Fund managed by DFG.

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The legislation tasks DWR with purchasing up to 1.6 million acre-feet of Colorado River water from IID, and selling the water to MWD under specified terms. Proceeds from sale of the water – estimated at up to $300 million – are to go to the Salton Sea Restoration Fund. The Secretary for Resources is directed to prepare a Salton Sea ecosystem restoration study and environmental document and identify a preferred alternative by the end of 2006. The study, to be conducted in consultation with a legislatively mandated advisory committee and with the Salton Sea Authority, is to include a proposed funding plan for implementing the preferred alternative.

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Accomplishments

Several large-scale water conservation actions involving Colorado River water users, as shown in Table 11-7. Development and implementation of these programs and projects have included environmental and environmental justice values.

Table 11-7
Existing Colorado River Region Water Conservation Actions / Agreements Since 1980

Year	Action	Participants	Comments/Status	Estimated Savings
1980	Line 49 miles of Coachella Canal	USBR, CVWD, MWD	Project completed.	132 taf/yr
1988	IID distribution system improvement and on-farm water management projects designed to conserve 110 taf/yr.	IID, MWD	Project completed. Under QSA agreement extends through 2037 (2047, if not terminated by SDCWA; 2077, if renewed by mutual consent of IID / SDCWA) Conservation projects - canal lining, regulatory reservoirs, lateral spill interceptor canals, tailwater return systems, non-leak gates, 12-hour water delivery, drip irrigation, and system automation. MWD funded $96.5 million (1988$) for program costs; pays O&M for duration of agreement.	Conservation verification in 1998 - 107 taf
1992	Groundwater banking in Arizona	MWD, Central Arizona WCD, So. Nevada WA	Test program to bank up to 300 taf.	MWD and SNWA have stored 139 taf in Arizona groundwater basins.
1992	PVID land fallowing	PVID, MWD	Project completed. Two-year land fallowing test program. Covered 20,215 acres in PVID.MWD paid $25 million to farmers over a two-year period.	186 taf were made available, but the water was subsequently released from Lake Mead when flood control releases were made from the reservoir.
1995	Partnership agreement	USBR, CVWD	Provides, among other things, for studies to optimize reasonable beneficial use of water in the district.	N/A
2003	Water transfer agreement (QSA)	IID, SDCWA, CVWD	Initial term of 35 years; 45 years if not terminated by SDCWA; 75 years if renewed by mutual consent of IID / SDCWA. SDCWA pays for water transferred & to Sea. CVWD pays for water transferred	In 2003, SDCWA receives 10 taf and the Salton Sea receives 5 taf. By 2017, SDCWA amount increases to 100 taf and the Salton Sea amount increases to 150 taf. From 2018 through the remainder of agreement (2077, if extended), SDCWA to receive 200 taf (from 2021 on) and the Salton Sea to receive 0 acre-feet (from 2018 on). CVWD receives 4 taf in 2008 and 103 taf by 2024. This decreases to 50 taf in 2048, if agreement is extended.
2003	Land lease agreement	PVID, CVWD	PVID conserved and transferred water supplies to CVWD.	40.6 taf in 2003.
2003	Canal Lining (QSA)	IID, CVWD, SDCWA, San Luis Rey River Indian Water Authority, other Indian tribes	Portions of the All American Canal and the Coachella Canal will be lined. SDCWA pays for construction and O&M. 16 taf will be provided for the Indian water rights settlement.	67.7 taf/yr - All American Canal 26 taf/yr - Coachella Canal
	PVID fallowing	PVID, WD		

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Relationship with Other Regions

After eight years of negotiations, the signing of the Quantification Settlement Agreement on October 10, 2003, facilitated a second long-term water transfer from the Imperial Irrigation District in the Colorado River Hydrologic Region to urban water users in the South Coast Hydrologic Region. It will also make possible the transfer of additional water to be obtained through lining of the All American and the Coachella Canals. The water transfer from IID will help stabilize SDCWA's and CVWD's water supplies, satisfy outstanding miscellaneous and Indian water rights, and provide funding that IID and farmers in the Imperial Valley will use for additional water conservation measures once the required fallowing is completed.

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Although the facilities to deliver SWP water supplies to the region have yet to be built, CVWD and DWA receive their annual allocations of SWP water through an exchange agreement with the South Coast Region's largest water wholesale agency, MWD. These districts are also participants in another agreement that delivers and stores water from the Colorado River in the Coachella Valley's largest groundwater basin during high flows.

Water districts in both regions are also cooperating in water conservation and land fallowing programs. The 1988 IID/MWD Water Conservation Agreement resulted in the conservation of water supplies from the building of new facilities, water system automation, and the implementation of technical assistance programs for farmers within the IID water service area. The conserved water is delivered to MWD.

As part of an on-going agreement, MWD will provide technical and financial assistance to the PVID for the construction of facilities and implementation of programs to conserve water supplies within the PVID service area. MWD will be permitted to divert conserved water supplies resulting from these projects and programs.

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Looking to the Future

On October 10, 2003, MWD, IID, CVWD and the Secretary of the Interior signed the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement (QSA) for the purpose of Section 5(B) of the Interim Surplus Guidelines. This agreement specifies, how, over time, California will reduce its use of Colorado River water to its basic apportionment of 4.4 million acre-feet per year in years for which the Secretary of the Interior does not declare a surplus on the Colorado River.

The QSA will remain in effect for 35 years, or 45 years if not terminated by SDCWA, or 75 years if renewed by mutual consent of IID and SDCWA. The QSA is expected to achieve the goal sought by the other Colorado River Basin states and the federal government of reducing California's use of Colorado River water to its annual basic apportionment of 4.4 million acre-feet. This reduction will be achieved through, among other practices, transfer of water use from IID to SDCWA and to CVWD. While it is the intent of IID to transfer water saved through conservation, from 2003 through 2012 all of the water transferred to SDCWA will come from land fallowing. Fallowing for the transfer will decrease from a high of 90,000 acre-feet per year in 2012, until by 2017 all water transferred to SDCWA will come from efficiency conservation measures. At the same time, additional land fallowing will occur to meet requirements (5,000 acre-feet per year in 2003, growing to 150,000 acre-feet in 2017, unless reduced or

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eliminated as a result of implementation of "Salton Sea Restoration") for environmental mitigation for the reduced agricultural return flows to the Salton Sea.

At its peak, land fallowing in the IID service area is anticipated to be up to 40,000 acres (to provide up to 150,000 acre-feet of mitigation water to the Salton Sea in 2017). After 15 years, it is expected that improvements in water use efficiency will meet the terms of the QSA, and land fallowing would no longer be needed for environmental mitigation. One of the fundamental long-term assumptions in MWD's Integrated Resources Plan is that MWD's Colorado River Aqueduct will be kept full by making water transfers from agricultural water users in the Colorado River Hydrologic Region (IID and PVID) to urban water users in the South Coast Hydrologic Region (SDCWA and MWD).

The agricultural water purveyors in the region (IID, PVID, CVWD, and Bard Water District) will continue to implement Efficient Water Management Practices. Water districts in the Coachella Valley will continue with their efforts to provide technical assistance to the managers of large landscape areas to help improve the efficiencies of irrigation.

CVWD and DWA will continue to work together to address declining water levels in the Coachella Valley's largest groundwater basin, the Indio sub-basin. CVWD is operating an active groundwater recharge program for the upper end of the Coachella Valley, generally, the urbanized part of the valley. CVWD recharges groundwater with imported Colorado River water and with Whitewater River flows using percolation ponds. CVWD and DWA levy extraction fees on larger groundwater users in the upper Coachella Valley.

With support from the Quechan Indian Reservation and from the Southern Low Desert Resource Conservation and Development Council, Bard Water District (BWD) is undertaking an $8 million project for capital improvements on the Reservation Division of the USBR's Yuma Project. This improvement project is in large part funded by a $4 million matching grant from the North American Development Bank. The Quechan Indian Reservation contributed $2 million of the matching funds and $2 million was raised by BWD customers. BWD is rehabilitating about 10 miles of earthen canals with concrete lining and pipeline in 2004, and an additional 10 miles are to be rehabilitated in 2005. BWD will also be replacing more than 100 irrigation gates and structures. These improvements will greatly increase the effectiveness of its system by reducing canal seepage and evaporation.

Over the years, the USBR and others have considered potential solutions to stabilize the Salton Sea's salinity and elevation. Most recently, the Salton Sea Authority has been performing appraisal level evaluations of some of the frequently suggested alternatives, such as large scale pump-in, pump-out pipelines to the Pacific Ocean. The authority is investigating integrated strategies where a smaller, lower salinity lake with a stable water surface would be coupled with treatment/desalination of some brackish inflows. The treated water could then be sold or could be part of a water transfer that would help fund the project.

The Colorado River Quantification Settlement Agreement (QSA), finalized and signed in October 2003, outlines key elements for California to operate within its basic annual allotment of 4.4 million acre-feet from the Colorado River.

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Key Elements of California's Colorado River Quantification Settlement Agreement

The California Colorado River Quantification Settlement Agreement and related agreements will have the following effects:

- Permit the utilization of interim surplus water.
- Transfer as much as 30 million acre-feet of water from farms to cities in Southern California over the up-to 75-year term of the agreement.
- Settle potential lawsuits between the Imperial Irrigation District and the U.S. Department of the Interior.
- Obligate California to permanently protect the wildlife dependent on the Salton Sea ecosystem.
- Provide for cooperation on the environmental review and mitigation for the IID/SDCWA Transfer Agreement, IID/CVWD Acquisition Agreement, and Salton Sea habitat conservation plan/natural community conservation plan.
- Fund a $200 million project to line a portion of the earthen All-American Canal which delivers Colorado River water to the Imperial Valley and a portion of the earthen Coachella Canal which delivers Colorado River water to the Coachella Valley, with concrete. Water conserved by reducing seepage will be transferred to San Diego, with SDCWA paying for construction and maintenance.
- Quantify, for the first time, the total Colorado River apportionments among some of the water districts within California.

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Water Portfolios for Water Years 1998, 2000, and 2001

Tables 11-8 through 11-10 present information about the water supplies and uses for the Colorado River Hydrologic Region. About 85 percent of the region's water is from surface deliveries from the Colorado River. Agricultural water demand makes up most of the water use in the region.

The high level of agricultural activity in the region is reflected by the large agricultural water demand relative to other water uses. In 2000, agricultural water demand made up almost 85 percent of all applied water demands in the region. By contrast, urban use only accounted for 14 percent of total demand.

Above average rainfall occurred during water year 1998. For water years 2000 and 2001, rainfall totals were below average; 2000 could be considered a dry year. In water year 1998, rainfall totals averaged 176 percent above average for the NWS station in Blythe, 104 percent of average for the El Centro 2 SSW station and 108 for Palm Springs.

Water year 2000 was very dry. Rainfall totals measured by the Blythe station for the year were only 17 percent of average; for El Centro, 10 percent of normal; and for Palm Springs, 35 percent of normal. Conditions improved slightly for water year 2001. The Blythe station measured rainfall that was 120 percent of normal. For El Centro, it was 78 percent of normal. For Palm Springs, it was 74 percent.

Despite the climatological conditions, demands for water supplies by the region's urban and agricultural users and the environment did not exhibit any large fluctuations during the period between 1998 and

2001. The total applied water demand for 1998 was 4,602,000 acre-feet. For 2000, the demand increased slightly to 4,726,900 acre-feet. In 2001, it decreased to 4,536,800 acre-feet.

Minor reductions in the irrigated crop acres occurred from 1998 to 2000, followed by a slight increase for 2001. Totals for the region were 761,760 acres in 1998, 731,890 acres for 2000, and 739,830 for 2001. Noticeable declines were observed for irrigated grains and other field crop categories. A steady increase was noted for the vegetables crops classified in the "other truck" category.

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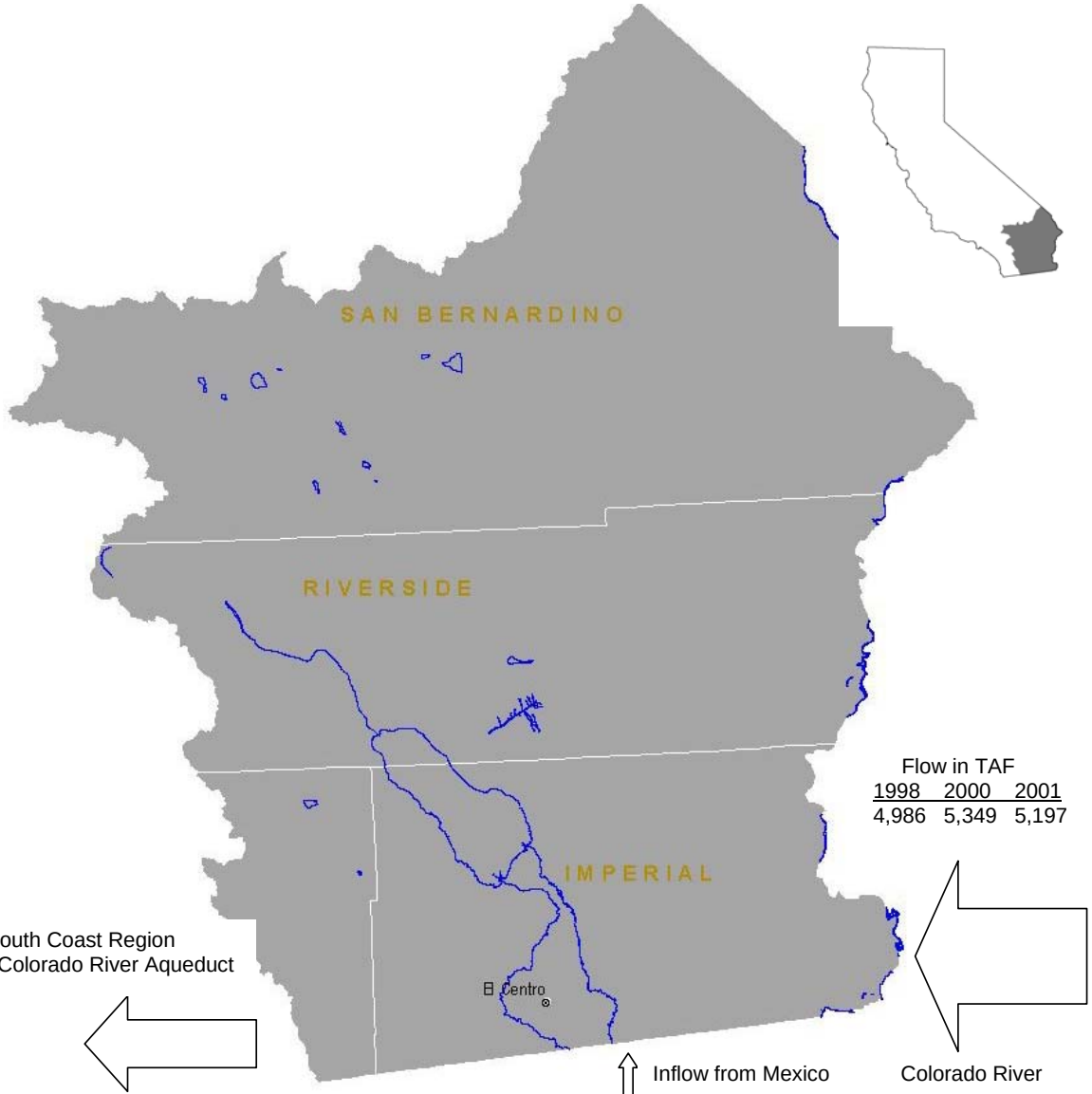
Figure 11-1
Colorado River Region

Revised March 7, 2005



Flow in TAF

1998	2000	2001
4,986	5,349	5,197

South Coast Region
Colorado River Aqueduct

Flow in TAF

1998	2000	2001
925	1,195	1,226

Inflow from Mexico

Flow in TAF

1998	2000	2001
182	166	155

Colorado River

Some Statistics

- Area - 19,962 square miles (12.6% of State)
- Average annual precipitation – 5.7 inches
- Year 2000 population - 606,535
- 2030 projected population – 1,166,550
- Total reservoir storage capacity - 620 TAF
- 2000 irrigated agriculture - 731,890 acres

Figure 11-2
Colorado River Hydrologic Region Population

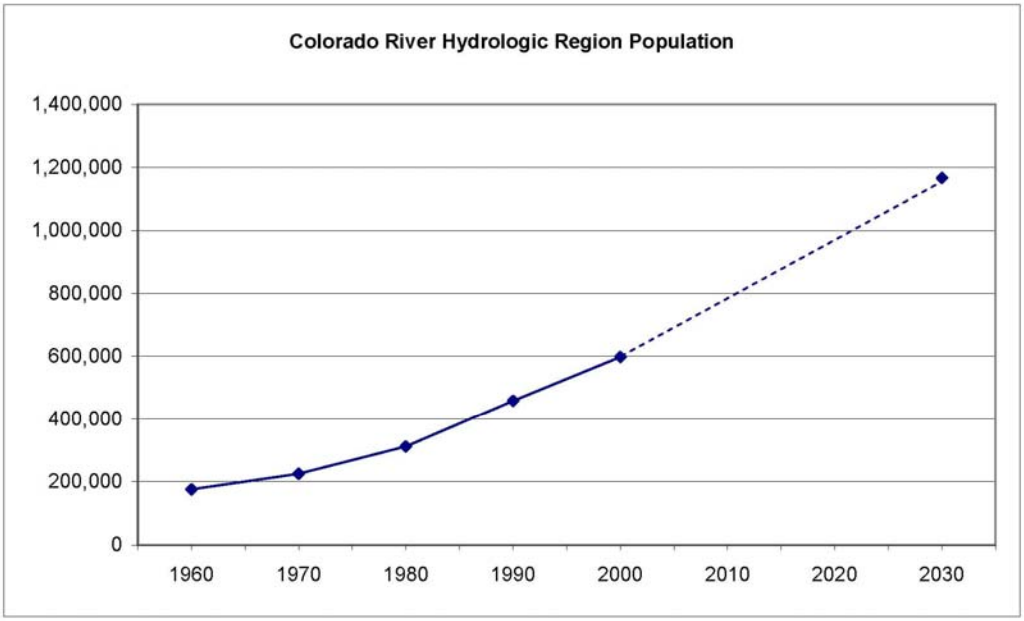


Figure 11-3
Colorado River Region Applied Water Uses For Water Years 1998, 2000, 2001

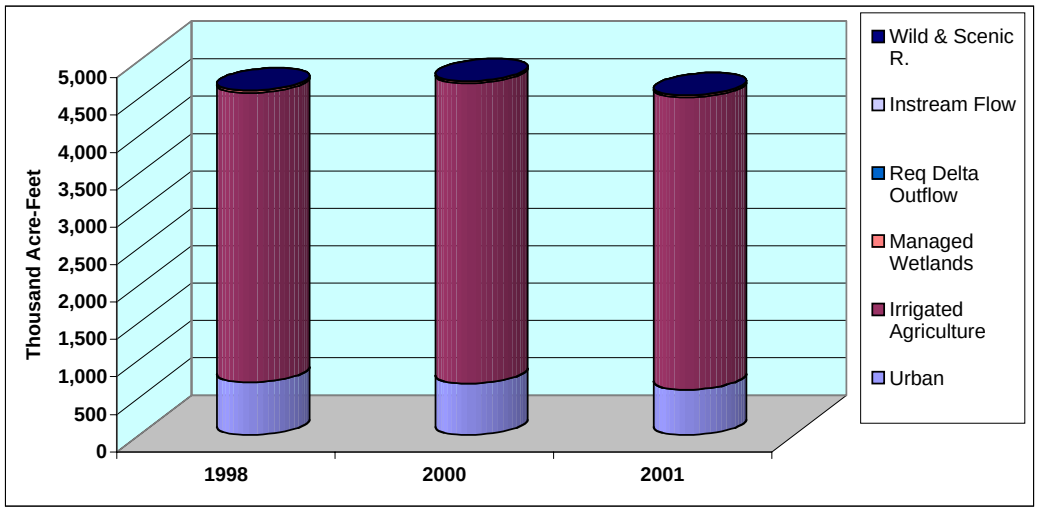


Figure 11-4
Colorado River Region Dedicated Water Supplies For Water Years 1998, 2000, 2001

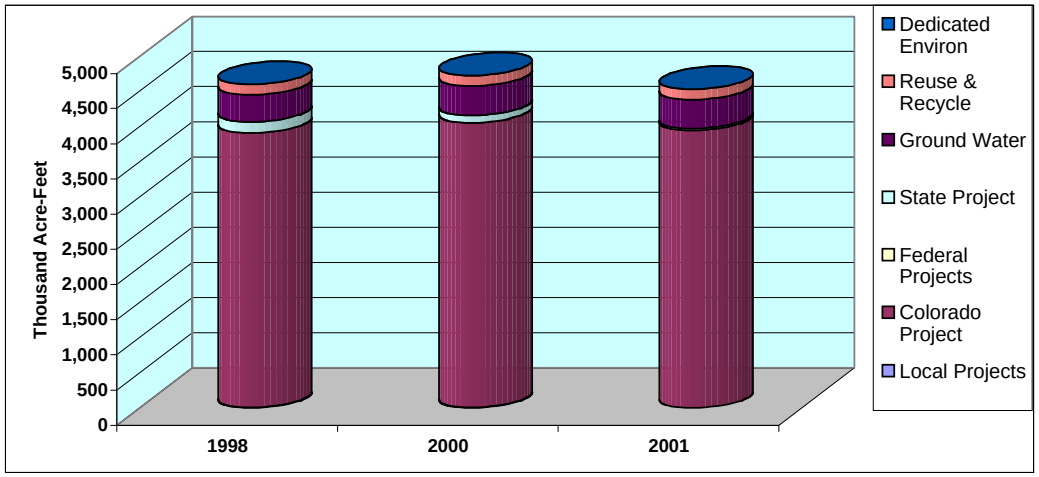


Table 11-8
Colorado River Region Water Balance Summary – TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	Water Year (Percent of Normal Precipitation)		
	1998 (154%)	2000 (50%)	2001 (80%)
Water Entering the Region			
Precipitation	9,455	3,034	4,770
Inflow from Mexico	182	166	155
Inflow from Colorado River	3,905	4,053	3,947
Imports from Other Regions	1,081	1,296	1,202
Total	**14,623**	**8,549**	**10,074**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	2,814	2,865	2,775
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	1,081	1,195	1,202
Statutory Required Outflow to Salt Sink	0	0	0
Additional Outflow to Salt Sink	1,185	1,252	1,228
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	9,491	3,320	5,025
Total	**14,571**	**8,632**	**10,230**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage			
Change in Surface Reservoir Storage	-15	-19	1
Change in Groundwater Storage **	68	-64	-157
Total	**53**	**-83**	**-156**

Applied Water * (compare with Consumptive Use)	4,107	4,288	4,174

* Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

**Footnote for change in Groundwater Storage

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – Spring 1997 to Spring 1998 for the 1998 water year and Spring 1999 to Spring 2000 for the 2000 water year. All other regions and Year 2001 were calculated using the following equation:

GW change in storage =
intentional recharge + deep percolation of applied water + conveyance deep percolation – withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow

Table 11-9
Water Portfolios for Water Years 1998, 2000 and 2001

Category	Description	Colorado River 1998 (TAF)				Colorado River 2000 (TAF)				Colorado River 2001 (TAF)				Data
Inputs:		Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	**Detail**
1	Colorado River Deliveries		3,905.1				4,053.0				3,946.6			PSA/DAU
2	Total Desalination		-				-				-			PSA/DAU
3	Water from Refineries		-				-				-			PSA/DAU
4a	Inflow From Oregon		-				-				-			PSA/DAU
b	Inflow From Mexico		182.4				165.6				154.7			PSA/DAU
5	Precipitation	9,454.8				3,033.9				4,769.9				REGION
6a	Runoff - Natural	N/A				N/A				N/A				REGION
b	Runoff - Incidental	N/A				N/A				N/A				REGION
7	Total Groundwater Natural Recharge	N/A				N/A				N/A				REGION
8	Groundwater Subsurface Inflow	N/A				N/A				N/A				REGION
9	Local Deliveries		6.6				6.3				4.0			PSA/DAU
10	Local Imports		-				-				-			PSA/DAU
11a	Central Valley Project :: Base Deliveries		-				-				-			PSA/DAU
b	Central Valley Project :: Project Deliveries		-				-				-			PSA/DAU
12	Other Federal Deliveries		-				-				-			PSA/DAU
13	State Water Project Deliveries		156.4				100.6				24.1			PSA/DAU
14a	Water Transfers - Regional		-				-				-			PSA/DAU
b	Water Transfers - Imported		-				-				-			PSA/DAU
15a	Releases for Delta Outflow - CVP		-				-				-			REGION
b	Releases for Delta Outflow - SWP		-				-				-			REGION
c	Instream Flow Applied Water		-				-				-			REGION
16	Environmental Water Account Releases		-				-				-			PSA/DAU
17a	Conveyance Return Flows to Developed Supply - Urban		-				-				-			PSA/DAU
b	Conveyance Return Flows to Developed Supply - Ag		-				-				-			PSA/DAU
c	Conveyance Return Flows to Developed Supply - Managed Wetlands		-				-				-			PSA/DAU
18a	Conveyance Seepage - Urban		-				-				-			PSA/DAU
b	Conveyance Seepage - Ag		-				-				-			PSA/DAU
c	Conveyance Seepage - Managed Wetlands		-				-				-			PSA/DAU
19a	Recycled Water - Agriculture		-				-				-			PSA/DAU
b	Recycled Water - Urban		16.1				17.2				17.9			PSA/DAU
c	Recycled Water - Groundwater		-				-				-			PSA/DAU
20a	Return Flow to Developed Supply - Ag		-				-				-			PSA/DAU
b	Return Flow to Developed Supply - Wetlands		-				-				-			PSA/DAU
c	Return Flow to Developed Supply - Urban		-				-				-			PSA/DAU
21a	Deep Percolation of Applied Water - Ag		47.8				48.8				44.6			PSA/DAU
b	Deep Percolation of Applied Water - Wetlands		-				-				-			PSA/DAU
c	Deep Percolation of Applied Water - Urban		109.4				161.6				168.4			PSA/DAU
22a	Reuse of Return Flows within Region - Ag		130.8				133.5				135.3			PSA/DAU
b	Reuse of Return Flows within Region - Wetlands, Instream, W&S		-				-				-			PSA/DAU
24a	Return Flow for Delta Outflow - Ag		-				-				-			PSA/DAU
b	Return Flow for Delta Outflow - Wetlands, Instream, W&S		-				-				-			PSA/DAU
c	Return Flow for Delta Outflow - Urban Wastewater		-				-				-			PSA/DAU
25	Direct Diversions	N/A				N/A				N/A				PSA/DAU
26	Surface Water in Storage - Beg of Yr	580.8				585.4				566.9				PSA/DAU
27	Groundwater Extractions - Banked	-				-				-				PSA/DAU
28	Groundwater Extractions - Adjudicated	-				-				-				PSA/DAU
29	Groundwater Extractions - Unadjudicated	387.0				416.3				408.8				REGION
Withdrawals:	**In Thousand Acre-feet**													
23	Groundwater Subsurface Outflow	N/A				N/A				N/A				REGION
30	Surface Water Storage - End of Yr	566.3				566.9				568.3				PSA/DAU
31	Groundwater Recharge-Contract Banking		-14.7				-59.2				-8.9			PSA/DAU
32	Groundwater Recharge-Adjudicated Basins		-				-				-			PSA/DAU
33	Groundwater Recharge-Unadjudicated Basins		-				-				-			REGION
34a	Evaporation and Evapotranspiration from Native Vegetation				N/A				N/A				N/A	REGION
b	Evaporation and Evapotranspiration from Unirrigated Ag				N/A				N/A				N/A	REGION
35a	Evaporation from Lakes				1,555.5				1,552.5				1,552.4	REGION
b	Evaporation from Reservoirs				120.0				121.5				120.6	REGION
36	Ag Effective Precipitation on Irrigated Lands		146.6				14.1				76.2			REGION
37	Agricultural Water Use		3,531.8	3,353.2	3,364.0		3,674.6	3,492.3	3,493.0		3,561.7	3,381.8	3,384.1	PSA/DAU
38	Managed Wetlands Water Use		31.6	31.6	31.6		30.2	30.2	30.2		29.6	29.6	29.6	PSA/DAU
39a	Urban Residential Use - Single Family - Interior		144.2				154.6				123.1			PSA/DAU
b	Urban Residential Use - Single Family - Exterior		57.1				55.8				67.4			PSA/DAU
c	Urban Residential Use - Multi-family - Interior		25.9				15.7				36.0			PSA/DAU
d	Urban Residential Use - Multi-family - Exterior		8.1				3.3				7.7			PSA/DAU
40	Urban Commercial Use		71.4				123.5				145.0			PSA/DAU
41	Urban Industrial Use		3.3				4.6				4.6			PSA/DAU
42	Urban Large Landscape		156.9				148.8				122.4			PSA/DAU
43	Urban Energy Production		76.7				76.7				76.7			PSA/DAU
44	Instream Flow		-	-	-		-		-		-	-	-	PSA/DAU
45	Required Delta Outflow		-	-	-		-		-		-	-	-	PSA/DAU
46	Wild and Scenic Rivers		-	-	-		-	-	-		-	-	-	PSA/DAU
47a	Evapotranspiration of Applied Water - Ag				2,560.4				2,627.3				2,548.5	PSA/DAU
b	Evapotranspiration of Applied Water - Managed Wetlands				31.6				30.2				29.6	PSA/DAU
c	Evapotranspiration of Applied Water - Urban				222.1				207.9				196.5	PSA/DAU
48	Evaporation and Evapotranspiration from Urban Wastewater				-				-				-	REGION
49	Return Flows Evaporation and Evapotranspiration - Ag				80.3				86.8				83.5	PSA/DAU
50	Urban Waste Water Produced	61.9				67.6				69.2				REGION
51a	Conveyance Evaporation and Evapotranspiration - Urban				13.9				14.4				14.6	PSA/DAU
b	Conveyance Evaporation and Evapotranspiration - Ag				64.0				64.0				64.0	PSA/DAU
c	Conveyance Evaporation and Evapotranspiration - Managed Wetlands				-				-				-	PSA/DAU
d	Conveyance Loss to Mexico				N/A				N/A				N/A	PSA/DAU
52a	Return Flows to Salt Sink - Ag				997.9				1,053.5				1,026.7	PSA/DAU
b	Return Flows to Salt Sink - Urban				187.4				198.3				201.0	PSA/DAU
c	Return Flows to Salt Sink - Wetlands				-				-				-	PSA/DAU
53	Remaining Natural Runoff - Flows to Salt Sink				-				-				-	REGION
54a	Outflow to Nevada				-				-				-	REGION
b	Outflow to Oregon				-				-				-	REGION
c	Outflow to Mexico				-				-				-	REGION
55	Regional Imports	1,081.3				1,296.0				1,202.0				REGION
56	Regional Exports	1,081.3				1,195.4				1,202.0				REGION
59	Groundwater Net Change in Storage	68.3				-63.9				-156.5				REGION
60	Surface Water Net Change in Storage	-14.5				-18.5				1.4				REGION
61	Surface Water Total Available Storage	620.4				620.4				620.4				REGION

Colored spaces are where data belongs. N/A Data Not Available "-" Data Not Applicable "0" Null value

Table 11-10
Colorado River Region Water Use and Distribution of Dedicated Supplies - TAF

	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	156.9			148.8			122.4		
Commercial	71.4			123.5			145.0		
Industrial	3.3			4.6			4.6		
Energy Production	76.7			76.7			76.7		
Residential - Interior	170.0			170.3			159.1		
Residential - Exterior	65.2			59.1			75.1		
Evapotranspiration of Applied Water		222.1	222.1		207.9	207.9		196.5	196.5
Irrecoverable Losses		76.6	76.6		82.8	82.8		84.6	84.6
Outflow		124.7	124.7		129.9	129.9		131.0	131.0
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
GW Recharge Applied Water	156.4			100.6			24.1		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Urban Use	**700.0**	**423.4**	**423.4**	**683.5**	**420.6**	**420.6**	**606.9**	**412.1**	**412.1**
Agriculture									
On-Farm Applied Water	3,531.8			3,674.6			3,561.7		
Evapotranspiration of Applied Water		2,560.4	2,560.4		2,627.3	2,627.3		2,548.5	2,548.5
Irrecoverable Losses		80.3	80.3		86.8	86.8		83.5	83.5
Outflow		723.3	723.3		778.9	778.9		752.1	752.1
Conveyance Losses - Applied Water	338.6			338.6			338.6		
Conveyance Losses - Evaporation		64.0	64.0		64.0	64.0		64.0	64.0
Conveyance Losses - Irrecoverable Losses		167.6	167.6		167.6	167.6		167.6	167.6
Conveyance Losses - Outflow		107.0	107.0		107.0	107.0		107.0	107.0
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Agricultural Use	**3,870.4**	**3,702.6**	**3,702.6**	**4,013.2**	**3,831.6**	**3,831.6**	**3,900.3**	**3,722.7**	**3,722.7**
Environmental									
Instream									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Wild & Scenic									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Required Delta Outflow									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Managed Wetlands									
Habitat Applied Water	31.6			30.2			29.6		
Evapotranspiration of Applied Water		31.6	31.6		30.2	30.2		29.6	29.6
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Total Managed Wetlands Use	31.6	31.6	31.6	30.2	30.2	30.2	29.6	29.6	29.6
Total Environmental Use	**31.6**	**31.6**	**31.6**	**30.2**	**30.2**	**30.2**	**29.6**	**29.6**	**29.6**
TOTAL USE AND LOSSES	**4,602.0**	**4,157.6**	**4,157.6**	**4,726.9**	**4,282.4**	**4,282.4**	**4,536.8**	**4,164.3**	**4,164.3**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	6.6	6.6	6.6	6.3	6.3	6.3	4.0	4.0	4.0
Local Imported Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colorado River Deliveries	3,905.1	3,905.1	3,905.1	4,053.0	4,053.0	4,053.0	3,946.6	3,946.6	3,946.6
CVP Base and Project Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Federal Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP Deliveries	156.4	156.4	156.4	100.6	100.6	100.6	24.1	24.1	24.1
Required Environmental Instream Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater									
Net Withdrawal	73.4	73.4	73.4	105.3	105.3	105.3	171.7	171.7	171.7
Artificial Recharge	156.4			100.6			24.1		
Deep Percolation	157.2			210.4			213.0		
Reuse/Recycle									
Reuse Surface Water	130.8			133.5			135.3		
Recycled Water	16.1	16.1	16.1	17.2	17.2	17.2	17.9	17.9	17.9
TOTAL SUPPLIES	**4,602.0**	**4,157.6**	**4,157.6**	**4,726.9**	**4,282.4**	**4,282.4**	**4,536.7**	**4,164.3**	**4,164.3**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Figure 11-5
Colorado River Region 1998 Flow Diagram
In Thousand Acre-Feet (TAF)

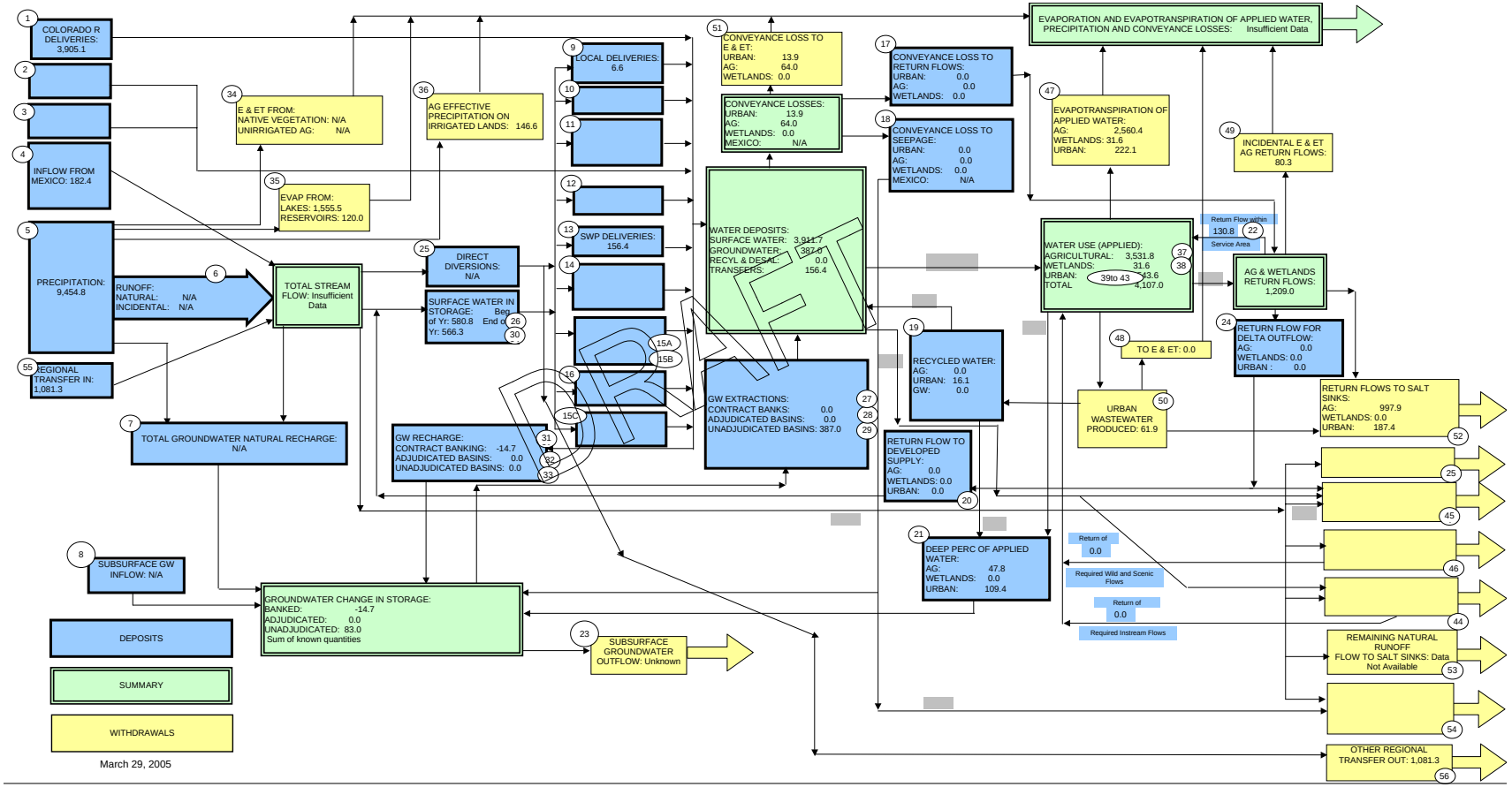


Figure 11-6
Colorado River Region 2000 Flow Diagram
In Thousand Acre-Feet (TAF)

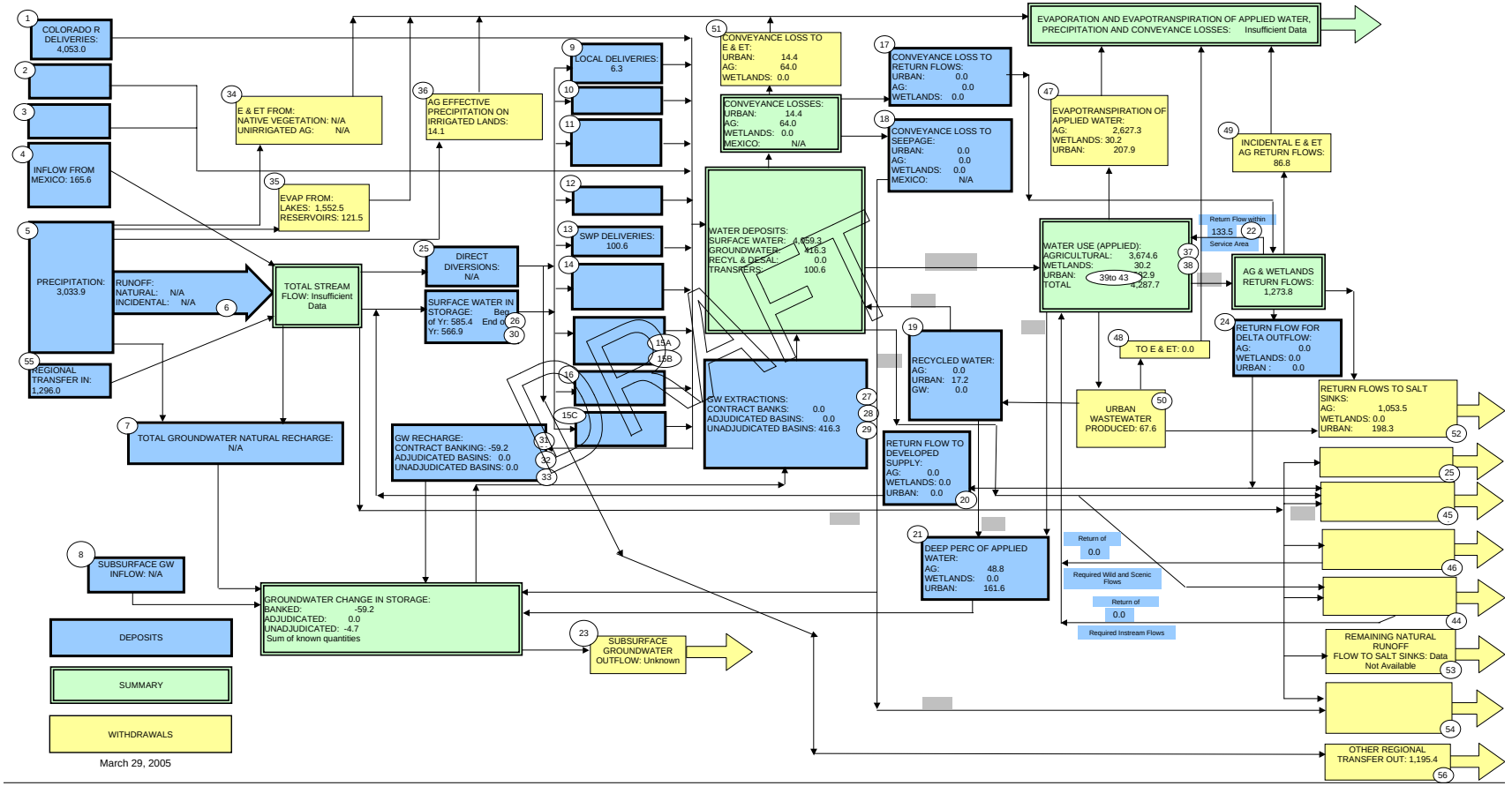
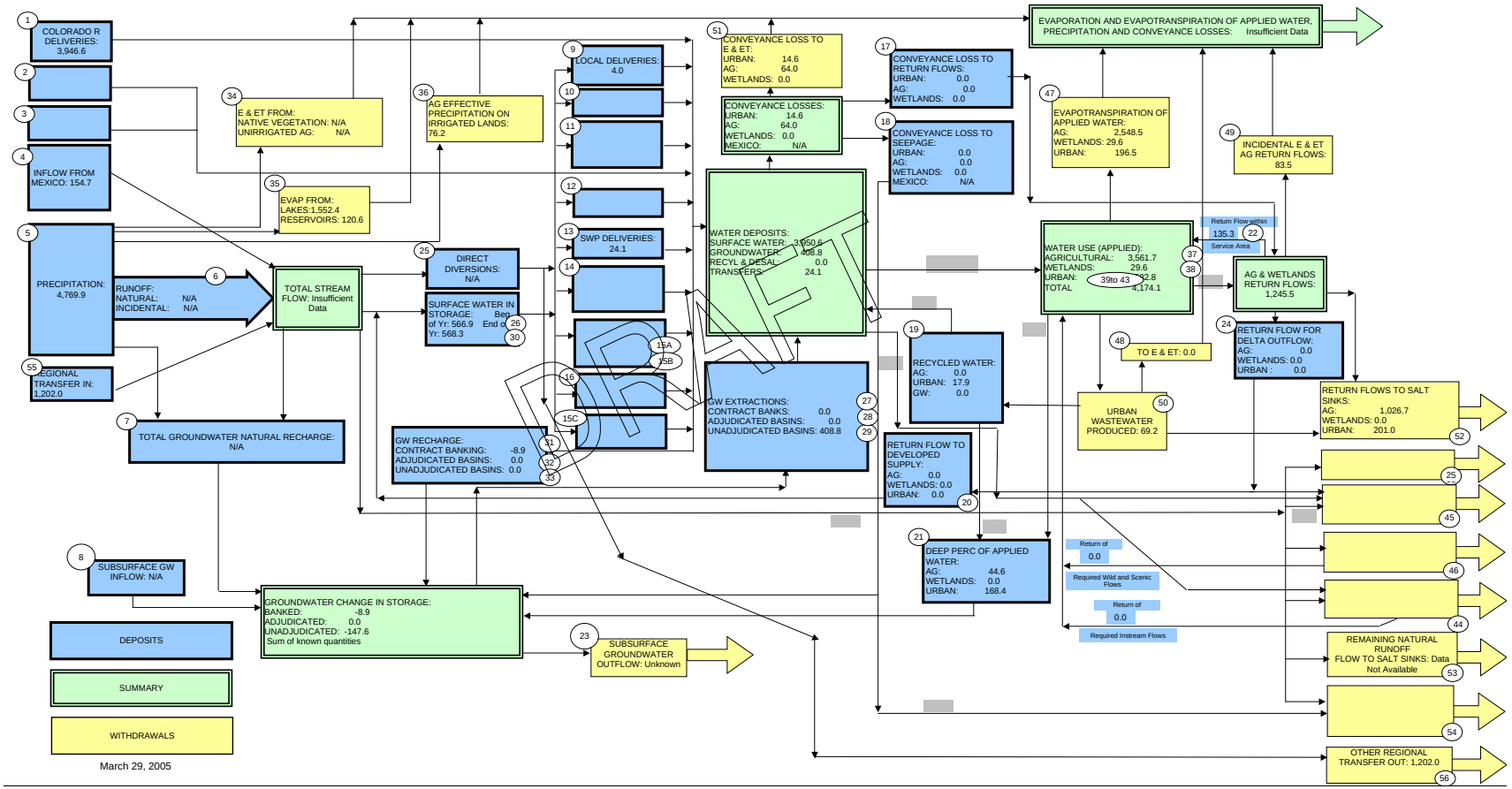


Figure 11-7
Colorado River Region 2001 Flow Diagram
In Thousand Acre-Feet (TAF)



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2003	IID / growers will implement projects to conserve up to 103 taf/yr.	IID, CVWD	Initial term 35 years; 45 years, if not terminated by SDCWA; 75 years if renewed by mutual consent of IID and SDCWA. CVWD pays for water transferred	In 2008, IID will transfer 4 taf to CVWD, increases to 103 taf/yr for 2026 – 2047. Decreases to 100 taf/yr, 2039 through 2077 (if extended)